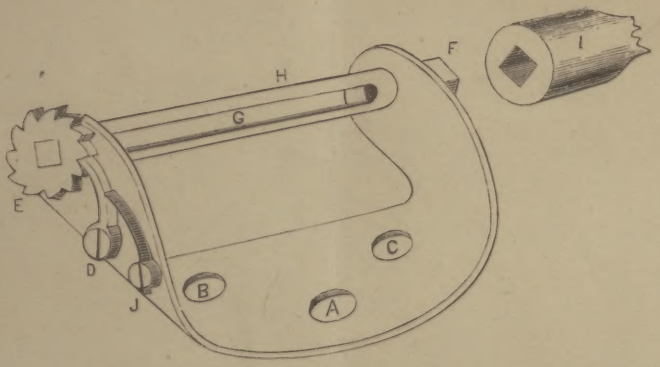
Denison (C.)

THE

EXTENSION WINDLASS,



AN EXTENSION AND ADJUSTING APPARATUS,
A DEVICE ESPECIALLY ADAPTED FOR TREATMENT OF FRACTURE OF THE PATELLA, FOR MAKING EXTENSION OF JOINTS, FOR USE IN THE TREATMENT OF CERTAIN DIFFICULT FRACTURES, AND AS A TOURNIQUET.

BY

CHARLES DENISON, M.D.,

DENVER, COLORADO.

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[*For Errata and Addenda, see p.* 10.]

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THE EXTENSION WINDLASS;

A Device especially adapted to the Treatment of Fracture of the Patella, for making Extension of Joints, and for Use in the Treatment of Certain Difficult Fractures.

By CHARLES DENISON, M. D.,
DENVER, COLORADO.

The extension windlass, which is now presented to the medical profession, was the principal part of an apparatus for treating fracture of the patella, invented by the writer in the spring of 1870. Since then, as opportunity offered, he has sought to simplify the instrument, and thus bring it into general use. Yet, though considerable thought and time in experimenting have been given to it, much improvement is undoubtedly possible through the suggestions and experiments of others.

The device is about the size of an ordinary watch, yet strong enough for the needs of any case, either the extension of joints or as an aid in the treatment of fractures.

It is various in its application, the form of splint or support being mostly left to the ingenuity of the surgeon.

In the treatment of fractures this method of extension (by a stationary winding-rod or windlass, with ratchet and pinion attachment) has a decided advantage over the ordinary method by pulley and weight, since the force of the former is governed by the requirements of the case, while that of the latter must vary somewhat in an inverse ratio to those requirements.[1]

[1] In making extension we cannot expect the muscular power to be overcome and its relations to the various states of the nervous system to remain *constant;* and yet, with a weight of twenty pounds, a constant

The accompanying cut (Fig. 1) represents the size and form of the extension windlass. The support for the winding-rod is made of sheet-brass, and the rod of about one-quarter-inch brass wire.

Fig. 1.

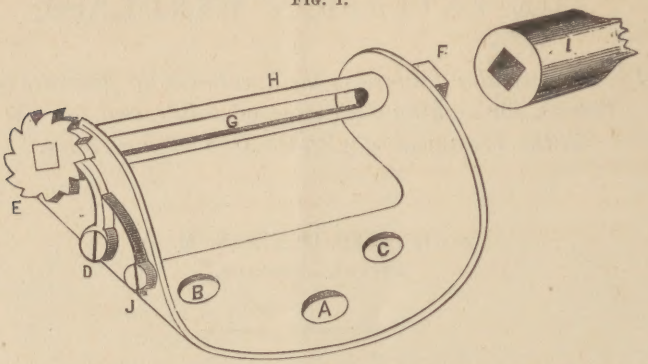

Fig. 1.—Extension Windlass.—*A*, *B*, and *C*, holes for screws or tacks; *H*, winding-rod, slotted at *G*, squared at *F* for key *I*, and held in position by ratchet *E* and pinion *D*, with spring-attachment *J*. Length of the winding-rod, two and one-quarter inches; between the arms of the brackets, one and three-quarters inch.

This device is attached to wooden supports or splints, by screws, so as to be either *swivel* (self-adjusting by one screw) or *stationary* (by two or more screws), as the surgeon wishes.[1]

force, it is sought to overcome another which naturally weakens. While so great a power may be necessary at first, still, as the opposing power lessens, its influence is really proportionately intensified. In this contest with a man's muscle and nervous system, a bag of sand has undue advantage. Then, too, there may be some uncertainty as to the amount of extension used by the pulley and weight. Some surgeons habitually weigh the sand or material used, instead of guessing at it, and then endeavor to regulate this weight as the case may require. Such are probably the exceptions. Now, if the maximum weight required (as Prof. Hamilton has found in making extension for fracture of the shaft of the femur) is twenty-two pounds, who can give us even an approximate rule for the weight necessary on successive days after the injury, as muscular contraction is gradually weakened, or that would be applicable to the great variety of cases occurring? The nearest to a correct guide would be *the length of the limb;* but this is just as reliable in extension by the windlass, which requires no more of muscles once relaxed, than to keep them under control.

[1] Or they can be fastened, if desired, by special screw and thumb-nut arrangement, to any part of a slotted adjustable metallic band, attached to the splint behind, and encircling the limb.

Fracture of the Patella.—Of several ways in which I have studied to apply this principle to the successful treatment of this fracture, the following is the simplest, and doubtless will most commend itself: A posterior splint is to be made of soft pine, to fit the convexity of the thigh and leg, with raised sides near the knee, which serve as points of attachment for the extension windlass, as shown in the following cut:[1]

The treatment is as follows: Fan-shaped adhesive plasters are cut of strong material, the broad portions, when applied, covering the quadriceps femoris below the middle of the upper third of the thigh; the other smaller ends, cut long enough, can be doubled on the adhesive side so as to give strength, and

FIG. 2.

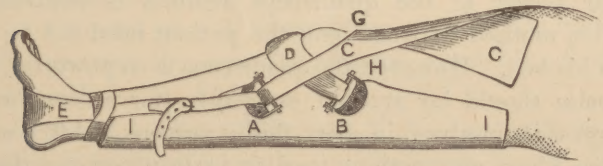

FIG. 2.—FRACTURE OF PATELLA.—*A A* and *B B*, extension and counter-extension windlasses, each fastened by one screw to wooden posterior splint; *C C*, fan-shaped adhesive plasters, crossing each other at *G*, and threaded through winding-rods *F F*; *D*, padded roller over ligamentum patellæ, the ends of which are threaded through winding-rods *H H*; *E*, reserve counter-extension to relieve *D* from uncomfortable pressure in front of knee. *I I*, point at which splint is bandaged to the limb.

prevent that portion sticking. Taking the intended positions of the lower windlasses as starting-points, these adhesive straps are applied to the anterior convexity of the thigh (previously shaved) so as to cross each other above the upper fragment. The limb is snugly bandaged from the toes, the adhesive straps above the point of their intersection being under the bandage. The splint is now adjusted to the limb, and the counter-extension arranged. That in front of the knee may be made of a broad, soft pad, covered with chamois-skin, or simply of cotton rolled in a strip of cloth, the ends of which are to be threaded through the slots in the upper winding-rods. The ends of the reserve counter-exten-

[1] A carpenter will glue two or three pieces together to make a hollow splint, or it may be hollowed out of a two-and-a-half or three-inch plank. The windlasses on the opposite side of the limb, in the illustrations, are simply indicated by doubling the letters referring to those shown.

sion, around the foot (which may be used if the pressure of the pad in front of the knee is excessive), and the small ends of the fan-shaped adhesive plasters, already applied, are threaded through the slots in the lower winding-rods, when the requisite extension or counter-extension should be made to bring the fragments close together. At the same time, care should be taken to smooth the wrinkled integument underneath the dressing, so as to make the apparatus comfortable. If necessary, a bandage may be applied over the knee, with pad underneath to keep the fragments from tilting. By means of the fine-toothed ratchets desirable tension may be daily kept upon the adhesive straps or knee-pad, and thus the principle of the "figure-eight bandage" is constantly in effect while the muscular power of the quadriceps femoris is neutralized. With this method of treatment the patient need not be confined to his bed. However, the quadriceps is so powerful, that its exercise should be avoided, especially (for reasons which will suggest themselves) in short, fleshy persons. After union has taken place, and perhaps earlier in lean persons, the patient may attend to his vocation, if not requiring much exercise, always being careful during the first few weeks to lift the injured limb with his hand when he wishes to elevate it, as in putting his foot in a chair, or rising from a sitting posture.[1]

This apparatus, rightly used, is capable of holding the fragments permanently in apposition, without undue constriction of the circulation. Plenty of room can be obtained

[1] It is important that an apparatus should be worn until after union has thoroughly taken place and become permanently established. Though opinions differ on this point, I believe this should be done even at the risk of some stiffness of the joint in consequence of this delay; and the first flexions of the knee should be made with caution. At the end of five weeks, if thought desirable, the posterior splint can be retained without the extension and counter-extension apparatus, and the patella confined in an elastic cap held down by a suitably-fitting ring. Later, too, the knee-cap can be continued, and, in place of the long posterior splint, a short, well-moulded posterior leather or gutta-percha splint may be substituted, the shape of which may be occasionally changed by soaking it in hot water, so as to allow of more and more motion in the joint. Passive flexion may be made once in a while, but complete flexion should not be allowed for several months.

underneath the extension-plasters, if needed, for leverage on the edges of the patella, by pads or other devices, and the force of the quadriceps is constantly overcome, unless the muscle is deeply buried in adipose or its great use excited. Without lengthening this article by a discussion of the causes of ligamentous union after this fracture, and of kindred subjects which would better show the utility of the extension-windlass, it is sufficient to state that a chief objection to most of the patella-splints yet devised is here obviated, in that the force to hold the fragments in apposition is not wholly expended on the tissues covering the bone. I think the use of this instrument will secure a greater success—more bony unions—in the treatment of this troublesome fracture than has usually hitherto obtained.[1]

For rupture of the ligamentum patellæ, the two lower windlasses with the counter-extension around the foot would answer well.

For the treatment of fracture of the olecranon process of the ulna, the arrangement of the windlasses is very similar to that for fracture of the patella. The splint, however, should be lighter, well padded, fitting the anterior convexity of the arm; and the counter-extension be made by adhesive straps crossed below the joint, as are those for extension above the broken fragments.

For fracture of the tuberosity of the os calcis, or rupture

[1] The results of two cases which I have treated with my apparatus are suggestive: one, from *direct injury* and much laceration of surrounding tissues, resulted in bony union; the other, from *muscular contraction*, with apparently no laceration of adjacent tissues, in a very fleshy, short man, resulted in union by ligament about half an inch long. From these results it occurs to me much light would be thrown on this subject, of bony or ligamentous union, by a well-tabulated record of the *results* as influenced by the *causes* of this fracture. So much does this idea impress me, that, if I had another case of this fracture from muscular contraction, I should make an effort to increase the amount of reparative material furnished, by rubbing the fragments together with force so as to arouse some surrounding inflammation at the point of fracture. At any rate, it is generally well to obtain crepitation at first, lest any of the surrounding tissues be interposed between the fragments, and thus affect the union.

of the tendo-Achillis, the following use of the windlasses is recommended: A light posterior splint is to be made for the calf of the leg, cut away where the heel should come, with a foot-piece braced at an obtuse angle to the same. Fan-shaped adhesive plasters are to be applied over the gastrocnemius, crossing above the heel, underneath which, and above the upper fragments of the os calcis, pads may be inserted. Then the leg, bandaged, is put in the splint. The windlasses are fastened to the sides of the foot-board below the instep by one screw, so as to be swivel, and the small ends of the traction-plasters threaded through the winding-rods, when the desired force may be brought to bear to control the troublesome muscle and hold the fragment of the os calcis down in place.

FIG. 3.

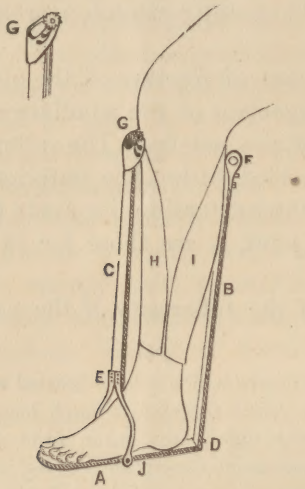

FIG. 3.—EXTENSION OF THE ANKLE-JOINT.—*A*, wooden foot-piece, about one-third inch thick, to which, at *D* and *J J*, the supports *C B*, of the extension-windlasses, *G F*, are fastened. *H I*, fan-shaped adhesive plasters in position. Braces to go over instep (after Dr. L. A. Sayre's apparatus) are fastened to slat *C*, at *E*. The windlasses, *G F*, are reversed and made stationary on the upper ends of the thin slats, so as to draw the adhesive plasters close to the limb, and over the winding-rods.

For making extension of the ankle-joint the following combination of foot-board, thin splints, and two extension-windlasses, is recommended. The wood part may be made light, so as not to be cumbersome.

The foot is secured to the foot-piece by several adhesive

strips, and then bandaged. The supports of the windlasses are afterward tightly screwed to the foot-piece at the heel, and below the instep, and the fan-shaped adhesive plasters properly secured to the leg, when the traction on these produces the required extension in the joint below.

This cut may be made to explain the use of the windlasses for extension of the knee and hip joints. The extension of the knee-joint is quite simple and effective. Two thin slats, similar to those in the cut, are to be used as side-splints, on the ends of which the extension-windlasses are reversed and made stationary. These supports are long enough to reach from the upper third of the thigh nearly to the ankle, the one on the inside being the shorter of the two. From one to three fan-shaped adhesive plasters are bandaged to the sides of the limb, above and below, the small ends of which converge toward the windlasses, and thus the traction of those above the knee is opposed to that of those below.

For extension of the hip-joint the perineal band may be used, with a long, light side-splint, on the lower end of which the extension-windlass is reversed and made stationary. The fan-shaped adhesive strips are applied to the outside and back of the calf of the leg, converging toward the winding-rod. In muscular adults it might be best to use also another extension-windlass, supported on the inside of the leg by a brace coming from the outside long splint.

Extension of the hip-joint could also be made by embedding the lower end of a long side-splint in a plaster-of-Paris bandage on the foot and leg (or by fastening the lower end of the splint by a brace, at right angles to it, to the sole of a shoe); while, on the upper end, above the crest of the ilium, two extension-windlasses might be made swivel, each pulling on a separate end of the perineal band. It will be apparent that several methods of dressing fractures of the femur might be combined with these methods of hip-joint extension.

But, for non-union after fracture of the shaft of the femur, I have devised the following dressing:

The thigh, being well protected by thick flannel or blanketing, is enveloped in a firm though not too tightly-fitting plas-

ter-of-Paris bandage, from the knee to past the gluteal fold. In this dressing, on the inside and outside aspect of the limb, are embedded the roughened ends of two thin side-splints, about two inches wide, and reaching to the ankle, on the lower ends of which the extension-windlasses are fastened as in extension of the knee-joint. The upward pressure of this dressing is prevented from causing excoriations by a roll of cotton, wrapped in oiled-silk, placed in the groin. This pad and the swell of the hip give counter-extension, while extension, sufficient to keep the limb of the same length as its fellow, is produced by the windlasses. The above treatment proved quite effective in a case of non-union which came under my care, and I think would be a satisfactory dressing for oblique fracture of the shaft of the femur, especially where long confinement in bed is sought to be avoided.

For both extra- and intra-capsular fracture of the cervix femoris a modification of this dressing also seems an excellent one, though as yet I have had no opportunity for testing its efficacy: First, bandage the thigh over the gluteal muscles and over the waist, placing underneath it, in the groin and gluteal fold, cotton rolled in oiled-silk, and suitable pads to protect any part from uncomfortable pressure. Then apply the plaster-of-Paris bandage, with splints embedded in it as shown above, except that the thigh and waist are to be included, the main strength of the dressing being on the outside of the hip. Afterward, should the dressing press uncomfortably in the groin, it could be cut away, and suitable pads introduced; but this would be avoided, in a measure, by trusting chiefly to the outside windlass for extension. By this method, the patient could be upon crutches, if desirable, and, at the same time the needed extension be continued.

For impacted fracture in the region of the ankle-joint, or oblique fracture of the tibia, the use of the windlasses for extension of the ankle-joint (Fig. 3) will suggest the peculiar way in which they might be fastened to the upper edges of the sides of a fracture-box, so that, when these sides are closed, the small, free ends of plasters, previously bandaged to the sides of the limb, can be threaded through the winding-rods,

and the desired extension produced, the foot, of course, being bandaged to the foot-board.

When the windlasses are used with the fracture-box, their position, as to the thigh, may be easily varied by first fastening them, reversed, as explained above, on the ends of thin slats, which may be screwed on to the sides of the fracture-box, so as to extend to any part of the thigh desired.

In this way I have easily kept up extension for four weeks, in a patient under treatment, at present writing, for compound comminuted fracture of the leg, with a loss of pieces of the tibia, weighing half an ounce.

In a similar way the windlasses might be reversed, and made stationary on little braces fastened to the sides of an ordinary posterior-splint with a foot-board to which the foot is secured. Or the leg, to the knee, might be put in a plaster-bandage, in which thin side-pieces are embedded, which reach to the upper third of the thigh. On the upper ends of these the windlasses are turned over, and made stationary, so as to make traction on fan-shaped adhesive plasters, bandaged to the sides of the thigh.

Two or three of the last uses of this instrument are rather suggestions than the results of actual trial. Enough has been written, however, to show that this extension-windlass can be of great service to the skillful surgeon, especially in a country-practice, and among those who are not able to purchase expensive apparatuses. The windlasses are manufactured by Messrs. Codman & Shurtleff, of Boston.

Errata.

Page 7, second line from top, "tightly screwed," should read *lightly screwed.*

In Fig. 2, page 3, the lower winding rod should be lettered F.

Addenda.

To use the Extension Windlass as a tourniquet, tie one end of a bandage, handkerchief, or piece of webbing, around the bracket, passing the other end around the limb and through the slot in the winding rod. If thought best, a pad may be placed underneath the windlass and over the vessels to be pressed.

The constriction desired is obtained by turning the winding rod with the key. The author is indebted to Dr. E. Andrews, of Chicago, for suggestions in this connection.

A simple extension of the hip-joint, for "hip disease," the knee being left free, can be made as follows: Make a wooden oval or triangular-shaped hip-piece four to eight inches long, with holes in the ends for fastening the perineal band, and hollowed out on the inside to fit the crest of the ilium. To the lower part of the centre of this, and over the hip joint, a thin slat, reaching to the knee-joint, is fastened loosely by one screw. Fan-shaped plasters are applied to the thigh, converging toward the lower end of the side slat, on which the windlass is made stationary.

If fixation of the hip-joint is preferred, it can be favored by having the wide hip-piece and the thin side splint fastened permanently together, or made of the same piece of wood.

The treatment recommended (at bottom of page 7) for non-union after fracture of the femur, is giving perfect satisfaction in a case of oblique fracture of that bone, under treatment at present writing. The pad previously placed in the groin should be a generous one.

Four windlasses are best used for treating fracture of the patella, and making extension of the knee-joint, while two will answer for most other uses. The surgeon with an average practice may have frequent use for four.

C. D.

Price of the Windlass, post-paid, each, $1.50.

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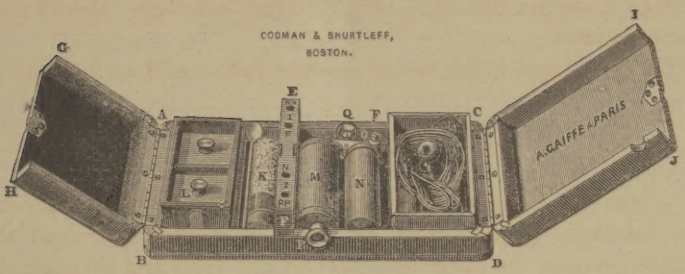

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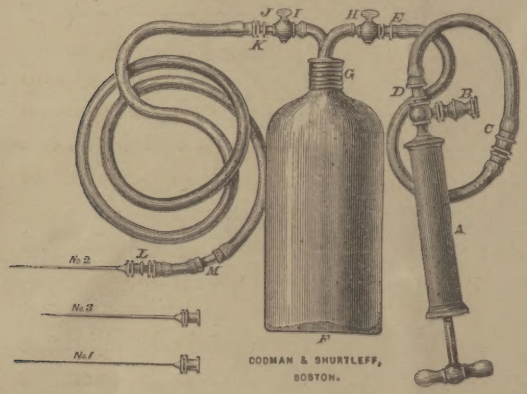

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